UART喚醒並且頻率補償

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

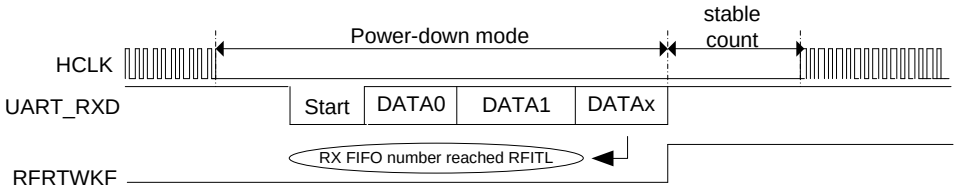
代碼簡述	本範例代碼使用UART把M480從低功耗模式喚醒並進行頻率補償
BSP 版本	M480 Series BSP CMSIS V3.04.000
開發平台	NuMaker-PFM-M487 Ver 3.0

1 功能介紹

1.1 簡介

此範例程式中，M480會進入power down模式，當所收到UART的資料達到門檻值，即會喚醒M480。由於power down模式下 UART 時鐘源需要設為 LXT，因此使用UART鮑率補償以達到更準確的頻率。使能暫存器WKRFRTEN(UART_WKCTL[2])可開啟UART喚醒功能。

進入power down模式後，當RX FIFO裡接收到的資料達到了門檻值設定 RFITL (UART_FIFO[7:4])，會觸發接收資料標誌 RFRTWKF(UART_WKSTS[2])。下圖是UART接收資料達到門檻值喚醒示意圖：



1.2 原理

使用者可以在BRCOMP(UART_BRCOMP[8:0])設定需要補償的位元，並且在BRCOMPDEC(UART_BRCOMP[31])設定正補償或是負補償，使所設定的位元資料時間增加或減少1個UART的時脈。以下為暫存器說明：

Bits	Description	
[31]	**BRCOMPDEC**	**Baud Rate Compensation Decrease** 0 = Positive (increase one module clock) compensation for each compensated bit. 1 = Negative (decrease one module clock) compensation for each compensated bit.
[30:9]	**Reserved**	Reserved.
[8:0]	**BRCOMP**	**Baud Rate Compensation Patten** These 9-bits are used to define the relative bit is compensated or not. BRCOMP[7:0] is used to define the compensation of UART_DAT[7:0] and BRCOM[8] is used to define the parity bit.

範例如下：

UART peripheral clock = 32.768K (LXT)

UART Baud rate = 9600, 1bit = 104.167us

原波形會產生3個UART時脈的時間來表示1個位元的UART資料 ((1 / 32.768K) * 3 = 91.55us)，波形如下：

設定補償暫存器如下：

BRCOMP[8:0] = 0x0010100101

BRCOMPDEC[31] = 0

因此在bit0, bit2, bit5, bit7會補償1個UART時脈的時間 = ((1 / 32.768K) * (3+1) = 122.07us)

波形如下：

開啟補償功能可以控制UART鮑率的誤差在± 0.5個UART時脈的時間以內。

2 代碼介紹

首先設定UART1的傳輸速率為9600，並且對bit0, bit2, bit5, bit7做頻率補償。接著開啟UART喚醒功能，再來設定UART接收資料的門閥值。其程式碼如下：

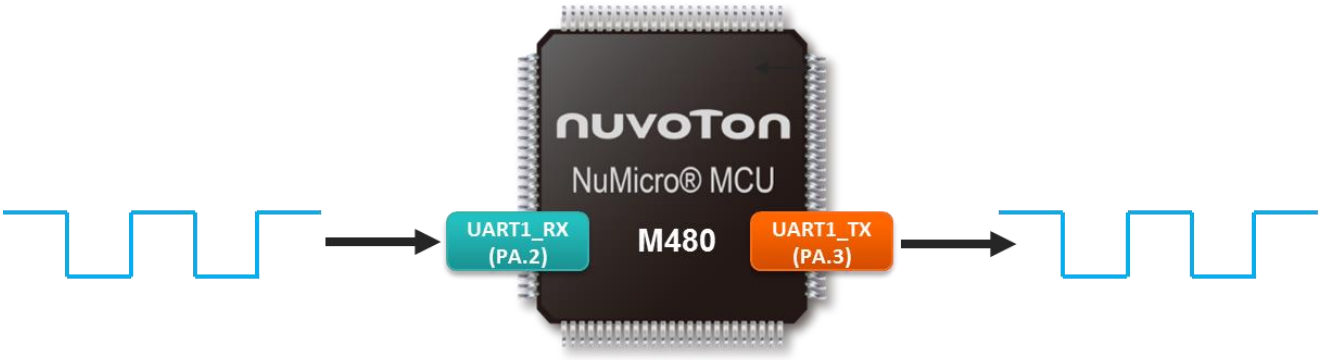
```
void UART_FunctionTest()
{
    SYS_UnlockReg();

    /* Configure UART1 and set UART1 baud rate */
    UART_Open(UART1, 9600);

    /* Set Compensation in bit0, bit2, bit5, bit7 */
    UART1->BRCOMP = 0xA5;

    g_bWait = 0;

    UART1->WKCTL = UART_WKCTL_WKRFRTEN_Msk;

    /* Enable UART RDA/THRE/Time-out interrupt */
    NVIC_EnableIRQ(UART1_IRQn);
    UART_EnableInt(UART1, (UART_INTEN_WKIEN_Msk));

    CLK->PWRCTL |= CLK_PWRCTL_PDWKIEN_Msk;
    NVIC_EnableIRQ(PWRWU_IRQn);

    /* clear status */
    UART1->WKSTS = UART1->WKSTS;

    /* Wait debug message finish */
    while((UART0->FIFOSTS & UART_FIFOSTS_TXEMPTYF_Msk) == 0);

    UART1->FIFO &=~ UART_FIFO_RFITL_Msk;
    UART1->FIFO |= UART_FIFO_RFITL_4BYTES;

    /* Enter to Power-down mode */
    CLK_PowerDown();

    while(!g_bWait);
    CLK_SysTickLongDelay(1000000);
```

```
    /* Disable UART RDA/THRE/Time-out interrupt */
    UART_DisableInt(UART1, UART_INTEN_WKIEN_Msk);
    g_bWait = TRUE;

    printf("\n\n%x\n",UART_READ(UART1));
    printf("\n\n%x\n",UART_READ(UART1));
    printf("\n\n%x\n",UART_READ(UART1));
    printf("\n\n%x\n",UART_READ(UART1));

    printf("\n\nUART Wakeup Compensation Sample Demo End.\n");
}
```

3 軟體與硬體環境

- **軟體環境**
  - BSP 版本
    - M480 Series BSP CMSIS V3.04.000
  - IDE 版本
    - Keil uVersion 5.26
- **硬體環境**
  - 電路元件
    - NuMaker-PFM-M487 or other M480 Development Board
  - 示意圖

    從UART1_RX(PA.2)輸入訊號，當資料達到門檻值時會喚醒M480。



4 目錄資訊

- EC_M480_UART_Wakeup_Compensation_V1.00
  - Library — Sample code header and source files
    - CMSIS — Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
    - Device — CMSIS compliant device header file
    - StdDriver — All peripheral driver header and source files
  - SampleCode
    - ExampleCode — Source file of example code

5 如何執行範例程式

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 UART_Wakeup_Compensation.uvproj
2. 進入編譯模式介面
   a. 編譯
   b. 下載代碼至記憶體
   c. 進入 / 離開除錯模式
3. 進入除錯模式介面
   a. 執行代碼

6 修訂紀錄

Date	Revision	Description
Oct. 1, 2019	1.00	1. 初始發布.

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